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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/629,888	07/29/2003	David W. Bartley	GRLK0078	5567
27268	7590	12/06/2006		EXAMINER
BAKER & DANIELS LLP 300 NORTH MERIDIAN STREET SUITE 2700 INDIANAPOLIS, IN 46204			OH, TAYLOR V	
			ART UNIT	PAPER NUMBER
				1625

DATE MAILED: 12/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>
	10/629,888	BARTLEY ET AL.
	<b>Examiner</b>	<b>Art Unit</b>
	Taylor Victor Oh	1625

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) Responsive to communication(s) filed on 14 June 2006.
- 2a) This action is **FINAL**.                    2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) Claim(s) 1-15, 17-32, 34 and 35 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) Claim(s) \_\_\_\_\_ is/are allowed.
- 6) Claim(s) 1-15, 17-32, and 34-35 is/are rejected.
- 7) Claim(s) \_\_\_\_\_ is/are objected to.
- 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on \_\_\_\_\_ is/are: a) accepted or b) objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) All    b) Some \* c) None of:
1. Certified copies of the priority documents have been received.
  2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) Notice of Informal Patent Application
- 6) Other: \_\_\_\_\_.

In view of the Appeal Brief filed on 6/14/06 as well as newly found prior art ,  
PROSECUTION IS HEREBY REOPENED. A new Office Action sets forth below.

**The Status of Claims:**

Claims 1-15, 17-32, and 34-35 are pending.

Claims 1-15, 17-32, and 34-35 have been rejected.

**DETAILED ACTION**

1. Claims 1-15, 17-32, and 34-35 are under consideration in this Office Action.

**Priority**

2. None.

**Drawings**

3. None.

***Claim Rejections - 35 USC § 112***

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-15 and 17-18 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for carbonates, alkali bicarbonates, alkalis ,and mixtures thereof as the decarboxylation catalyst, does not reasonably provide enablement for any catalysts generally. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to include all kinds of catalysts unrelated to the claimed invention commensurate in scope with these claims.

Furthermore, the instant specification fails to provide information that would allow the skilled artisan to practice the instant invention without undue experimentation. Attention is directed to *In re Wands*, 8 USPQ2d 1400 (CAFC 1988) at 1404 where the court set forth the eight factors to consider when assessing if a disclosure would have required undue experimentation, citing *Ex Parte Forman*, 230 USPQ 546 (BdApls 1986) at 547 the court recited eight factors:

- 1) the quantity of experimentation necessary,
- 2) the amount of direction or guidance provided,
- 3) the presence or absence of working examples,
- 4) the nature of the invention,
- 5) the state of the prior art,
- 6) the relative skill of those in the art,
- 7) the predictability of the art, and
- 8) the breadth of the claims.

### The Nature of the Invention

The nature of the invention is

1. A method for preparing tetrabromobenzoate ester from tetrabromophthalic anhydride comprising the steps of:
  - combining the tetrabromophthalic anhydride and an alcohol in at least one reaction vessel to form a first reaction mixture;
  - heating the first reaction mixture to a temperature that favors partial esterification over complete esterification to form a tetrabromophthalate half-ester intermediate mixture;
  - feeding the tetrabromophthalate half-ester intermediate mixture and a catalyst to at least one heated reactor having a temperature that favors decarboxylation over esterification; and
  - maintaining the at least one reactor at the temperature that favors decarboxylation over esterification to produce a tetrabromobenzoate ester-containing product.

### The State of the Prior Art

The states of the prior art are described as followed:

Hill et al (U.S. 5,637, 757) discloses the method of preparing tetrabromobenzoate esters in the following example :

**Synthesis of 2-ethylhexyltetrabromobenzoate from tetrabromophthalic anhydride in 2-ethoxyethylether solvent**

Tetrabromophthalic anhydride (1391 g., 3.00 moles), 2ethylhexanol (469 g, 3.60 moles), 2-ethoxyethylether (771 g, 4.75 moles), and sodium bicarbonate (25 g, 0.30 moles) were charged to a stirred, glass vessel. The mixture was brought to reflux, with the water of reaction being collected in a Dean-Stark trap. After CO<sub>2</sub> evolution had ceased (approximately 3 hours), the reaction was cooled and filtered to remove the catalyst. The 2-ethoxyethylether and excess 2-ethylhexanol were stripped off under vacuum yielding a clear, amber liquid product. GLC assay 85.0% tetrabromobenzoate, 1.6% tetrabromophthalic diester; OBr 56.99%; TGA 5% wt. loss 209° C., Gardner color 11.

Rose et al (US 5,728,760) teaches the method of making a brombenzoate compound useful for producing flame retarded polyurethanes in the followings:

**Synthesis of 2-ethylhexyltetrabromobenzoate From  
2,3,4,5-tetrabromobenzoic Acid**

2,3,4,5-Tetrabromobenzoic acid (438 g, 1.0 mole) prepared via the decarboxylation of tetrabromophthalic anhydride, 2-ethylhexanol (195 g, 1.5 moles) and titanium isopropoxide (2.2 g, 0.008 mole) were charged to a stirred, glass vessel. The mixture was heated at 200° C. in nitrogen atmosphere under stirring for 8 hours with the water of reaction being collected in a Dean-Stark trap. The resulting dark-brown reaction mixture was cooled to 90° C. and neutralized by stirring with solid  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  (5 wt % on the reaction mixture) at 90° C. for 1 hour. Following a steam-strip to remove excess 2-ethylhexanol, the product was filtered to remove the insoluble solid contaminants. A clear, dark-brown liquid was obtained (533 g, 97% yield). This crude product was distilled at 192°–194° C. and 0.1–0.2 mmHg. A total of 527 g of pale yellow, clear liquid was obtained (99% recovery). GLC assay 96.2% tetrabromobenzoate; OBr 56.6% (58.1% theory); acidity 0.15 meq.KOH/100 g; TGA 5% wt. loss at 271° C.; Gardner Color 3.

Finley (U.S. 4,375,551) teaches a process of preparing allylic esters of tetrabromophthalic acid in the presence of sodium carbonate from tetrabromophthalic anhydride in a two step procedure. The first and second steps of the process can be carried out in the same and different vessels; the reaction temperature of the first step is from 90 to 95° C. Finley has offered guidance that the rate at which the semi-esterification in the first step depends on the temperature of the reactants.

Stults et al (WO 98/57920) discloses the followings:

The invention relates generally to esters of tetrahalophthalate, and, more specifically to three classes of tetrahalophthalate esters. Regarding tetrahalophthalates in general, it is well known that they may be made by providing a tetrahalophthalic compound selected from the group consisting of tetrahalophthalic anhydrides and tetrahalophthalic acids, and reacting the same with an alkanol, preferably in the presence of an acid catalyst. With respect to the tetrabromophthalic compound, the anhydride is more readily available and therefore is the most preferred form. It is also contemplated herein that a tetrachlorophthalic compound may be mixed with a tetrabromophthalic compound in certain preferred aspects of the invention. With respect to the alkanol, linear alkanols are typically used in known processes, such as the processes described in U.S. Patent No. 5,049,697 or U.S. Patent No. 5,308,366, for example. The tetrahalophthalic compound is esterified with a catalyst which may be, for example, an alkyl titanate catalyst, zirconium tetrabutoxide or tin oxalate.

Day et al (US 5,728,323) discloses the followings:

A process for the preparation of dialkyl tetrahalophthalates. A tetrahalophthalic anhydride or acid is dissolved in excess  $C_1-C_{18}$  alkanols. Residual sulfuric acid is removed by treatment with magnesium acetate or multiple water washes. The mass is esterified with a tetraalkyl titanate, and residual acidic components are removed by treatment with magnesium silicate. These treatments improve processability, production cycle time, product color, clarity and purity.

As the prior art have been discussed in the above, there is no conclusive data that all kinds of catalysts would work to produce the final desired product except some catalyst, such as, sodium carbonate, an alkyl titanate tin oxalate, zirconium tetrabutoxide.

**The predictability or lack thereof in the art**

In the instant case, the instant claimed invention is highly unpredictable since one skilled in the art would recognize that any catalyst would not work on the claimed process in the same way as those catalysts such as carbonates, alkali bicarbonates, alkalis, and mixtures thereof disclosed in the specification. For example, Gardener (US 3,878,261) discloses the super acid catalyst of  $SbF_5$  and  $CF_3SO_3H$  used for isomerizing paraffins containing 4 to 12 carbons in a feed stream (see abstract page); furthermore, according to the text book, March's Advanced Organic Chemistry (March et al, 4<sup>th</sup> ed. 1992), it describes that another super acid,  $FSO_3H-SbF_6$ , is used in the formation of a carbocation, such as tert-butyl cation (see p. 219, the fourth paragraph) from isobutane unlike the claimed process.

Furthermore, the specification of the claimed invention does support the very idea of the unpredictable aspect of the catalysts by disclosing those specific and workable catalysts for the decarboxylation in the above, not all kinds of the catalyst known in the art.

Moreover, chemical reactions are well-known to be unpredictable, *In re Marzocchi*, 169 USPQ 367, *In re Fisher*, 166 USPQ 18. Additionally, catalytic processes, such as are present here, are inherently unpredictable. The U.S. District Court District of Connecticut held in *MOBIL OIL CORPORATION v. W.R. GRACE & COMPANY*, 180 USPQ 418 that "there is an inherent mystery surrounding the unpredictability of the performance of catalysts; a mystery which is generally recognized

and acknowledged by chemists in the cracking art. This is one more reason why the presumption of patent validity "should not be disregarded especially in a case of this sort where the intricate questions of [bio]chemistry involved are peculiarly within the particular competence of the experts of the Patent Office." *Merck & Co. v. Olin Mathieson Chemical Corp.*, 253 F.2d 156, 164, 116 USPQ 484, 490 (4th Cir. 1958)". "The catalytic action can not be forecast by its chemical composition, for such action is not understood and is not known except by actual test, *Corona Cord Tire Co. v. Dovan Chemical Corp.*, 276 U.S. 358, 368-369 (1928). Also see, *Application of Grant*, 304 F.2d 676, 679, 134 USPQ 248, 250-251 (CCPA 1962); *Rich Products Corp. v. Mitchell Foods, Inc.*, 357 F.2d 176, 181, 148 USPQ 522, 525-526 (2d Cir. 1966), cert. denied 385 U.S. 821, 151 USPQ 757 (1966); *Ling-Temco-Vought, Inc. v. Kollsman Instrument Corp.*, 372 F.2d 263, 268, 152 USPQ 446, 450-451 (2d Cir. 1967); *Georgia-Pacific Corp. v. United States Plywood Corp.*, 258 F.2d 124, 132-133, 118 USPQ 122, 128-129."

Therefore, from the above, it is clear that the use of a generic phrase "a catalyst" can not ensure to form the desired claimed product in a good yield.

**The amount of direction or guidance present**

The direction present in the instant specification is that not any catalyst can be led to the formation of the desired product. According to the specification, it is silent as to how any catalyst can be led to the formation of the desired product and fails to

provide guidance as to whether any catalyst is sufficient enough to allow to form the desired product in sufficient quantities; the specification fails to provide a correlation between the claimed process of the invention and the functional language of any catalyst .

**The presence or absence of working examples**

In the instant case, the claim encompasses all the various catalysts. Applicants' specification provide only two particular exemplified catalyst compounds ,such as sodium carbonate and sodium bicarbonate as shown in the examples I and III for producing the desired compound in the specification. In addition, the value of  $pK_b$  for sodium carbonate is 0.1 as shown in in Wikipedia (see pages 1-3, November, 2006) ; from this information, it follows that the optimum workable  $pK_b$  range for the claimed process is in the vicinity of 0.1. However, this can not be the representatives for all the of  $pK_b$  range of the basic catalysts of the claimed invention, which would work for the claimed process. Thus, the specification fails to provide working examples as to how other types of catalysts can be resulted in the claimed products, i.e. again, there is no correlation between the functional language of any catalyst and the desired final product.

However, these can not be the representatives for all the catalysts which would work for the claimed process. Thus, the specification fails to provide working examples as to how other types of catalysts can be resulted in the claimed products, i.e. again, there is no correlation between the functional language of any catalyst and the desired final product.

**The breadth of the claims**

The breadth of the claims is that any catalyst would work on the claimed process in the same way as those disclosed catalyst in the specification without considering the affect or impact of the different types of acidic catalysts on the starting compounds; for example, the super acid  $\text{FSO}_3\text{H-SbF}_6$  disclosed in March's Advanced Organic Chemistry (March et al , 4<sup>th</sup> ed. 1992) has a high likelihood of removing hydrogen ions from either of the reactants, the tetrabromophthalic anhydride and the alcohol instead of helping them to form the desired tetrabromobenzoate ester product , thereby detrimentally affecting the yield of the desired final product.

**The quantity of experimentation needed**

The quantity of experimentation needed is undue experimentation. One of skill in the art would need to determine which one of the catalysts would be capable of forming the desired product and would furthermore then have to determine which one of the catalysts would not be resulted in the claimed desired compounds in a sufficient quantity.

**The level of the skill in the art**

Even though the level of skill in the esterification is high, based on the unpredictable nature of the invention and the state of the prior art and the extreme breadth of the claims and lack of guidance and direction for other types catalysts than those disclosed catalysts in the specification, one skilled in the art could not employ the claimed invention without undue experimentation. The quantity of experimentation needed is undue experimentation.

Therefore, in view of the Wands factors and *In re Fisher* (CCPA 1970) discussed above, to practice the claimed invention herein, a person of skill in the art would have to engage in undue experimentation to test which acidic catalyst can be employed to produce the desired claimed compound encompassed in the instant claims, with no assurance of success.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1,15,19, 32, and 34 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claims 1,15,19, 32, and 34 and their corresponding dependent claims, the term "the tetrabromobenzoate ester-containing product" is recited. The expression is vague and indefinite because the phrase "the tetrabromobenzoate ester-containing product" would mean that there are other components besides the tetrabromobenzoate ester in the product ; there is uncertainty as to what other compounds are present in the product. Furthermore, It is well-settled that the term " containing " do not exclude the presence of other ingredients than the one recited. *Ex parte Muench* , 79 USPQ 92 (PTO Bd. App. 1948). Therefore, an appropriate correction is required.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-8, 17,19, 24-25,27,31, and 34 are rejected under 35 U.S.C. 102(b) as being anticipated clearly by Spatz et al (I & EC Product Res. and Dev. 8, no. 4, 1969, p. 381-391).

Spatz et al discloses the followings (see page 382, right col., lower paragraphs):

**MONOESTER OF TBPA.** The reaction of TBPA with several monohydric alcohols, effected by heating in a 200 to 500% excess of the alcohol, yielded the monoesters indicated in Figure 3. The reactions were complete in about 1 hour, as indicated by solution of the difficultly soluble TBPA. The monoesters were isolated by solvent concentration, filtration, and in vacuo drying at room temperature, except for the 2-ethylhexyl derivative. This product was isolated by cooling to 70° to 100°C. and

ROH plus. TBPA	Monogester Neut. equiv.		Melting Behavior		
	Fd.	Th.	Monogester M.P. (°C)	Resolidification Temperature (°C)	TBPA M.P. (°C)
CH <sub>3</sub> OH	496	496	140°, sinters	—	273-281°
C <sub>2</sub> H <sub>5</sub> OH	510	509	113-115°	120°	278-288°
2-C <sub>5</sub> H <sub>11</sub> OH	554	552	107-112°	119-190°	270-274°
C <sub>6</sub> H <sub>13</sub> OH*	603	594	115-119°	135-140°	170°

\* 2-Ethylhexanol

Δ Low m.p. probably due to presence of unevaporated 2-ethylhexanol

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clarifying by filtration through Super Cel if not clear, followed by cooling the filtrate to 0°C., filtration, washing with Skellysolve C, and drying in vacuo at room temperature.

The monoesters, on heating in the dry state, dissociated into the anhydride and the alcohol, as evidenced by their melting point behaviors (Figure 3). By their method of synthesis and isolation, it is obvious that the monoesters, once formed, maintain their structural identity during the short period of heating in the solvent.

**DIESTERIFICATION OF TBPA.** The study with monohydric alcohols to yield diesters proved informative. It showed (Table I) that diesterification—esterification of the second carboxy group—increased at temperatures above 175° and prolonged heating. Decarboxylation occurred little or not at all up to 185°, and then became perceptible above 185°C. The substantial decarboxylation at 195–200°, occurring at about the same rate as the esterification of the second carboxy group (Figure 5), indicated an upper temperature limit for a reasonable diesterification with minimal side reaction.

The total reaction (column 4), signifying loss of the second carboxy group by diesterification or decarboxylation, is equal to the sum (column 7) of the per cent diester formed, as determined by removal of the monester by alkaline washes (column 5) and the per cent CO<sub>2</sub> evolved (column 6) (Table I).

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**REACTION OF A SIMPLE POLYESTER WITH TBPA.**  
Polyesterification in the usual manner of a simple system, 2.2 DEG/1.0MA/0.5PA, gave a polyester with an acid number of 13.7 (Figure 4). Addition of 0.5 mole of TBPA to the hot polyester yielded a new one, having an acid number of 63.5. This compared favorably with the theoretical acid number of 59.9 for the new polyester, calculated on basis of TBPA conversion to the monoester (Figure 4). The second step was complete in one-half hour, the time required to dissolve the TBPA. A further drop in the acid number was, however, very slow and probably due to diesterification, decarboxylation, or both, as indicated in the next section.

(see page 383, left

col.).

In the TBPA-polyester resins, a diverse range of glycol, unsaturated acid, thin-out acid, and crosslinking agent may be used with retention of fire-retardancy, if the Br content of the resin is above ca. 12.5% by weight. In TBPA-epoxy resins, even less Br, about 9 to 11%, imparts fire-retardancy.

(see page 390, left

col.).

This is identical with the claims.

### ***Claim Rejections - 35 USC § 103***

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-15, 17-32, and 34-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Spatz et al (I & EC Product Res. and Dev. 8, no. 4, 1969, p. 381-391) in view of Hill et al (U.S. 5,637, 757).

Spatz et al discloses the followings (see page 382, right col., lower paragraphs):

**MONOESTER OF TBPA.** The reaction of TBPA with several monohydric alcohols, effected by heating in a 200 to 500% excess of the alcohol, yielded the monoesters indicated in Figure 3. The reactions were complete in about 1 hour, as indicated by solution of the difficultly soluble TBPA. The monoesters were isolated by solvent concentration, filtration, and in vacuo drying at room temperature, except for the 2-ethylhexyl derivative. This product was isolated by cooling to 70° to 100° C. and

ROH plus. TBPA	Monoester		Melting Behavior		
	Neut. Equiv. Fd.	Th.	Monoester M.P. (°C)	Resolidification Temperature (°C)	TBPA M.P. (°C)
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2-C <sub>5</sub> H <sub>11</sub> OH	534	532	107-112°	119-190°	270-274°
C <sub>8</sub> H <sub>17</sub> OH*	603	594	113-119°	135-140°	170°

\* 2-Ethylhexanol

Δ Low m.p. probably due to presence of unevaporated 2-ethylhexanol

clarifying by filtration through Super Cel if not clear, followed by cooling the filtrate to 0° C., filtration, washing with Skellysolve C, and drying in vacuo at room temperature.

The monoesters, on heating in the dry state, dissociated into the anhydride and the alcohol, as evidenced by their melting point behaviors (Figure 3). By their method of synthesis and isolation, it is obvious that the monoesters, once formed, maintain their structural identity during the short period of heating in the solvent.

**DIESTERIFICATION OF TBPA.** The study with monohydric alcohols to yield diesters proved informative. It showed (Table I) that diesterification—esterification of the second carboxy group—increased at temperatures above 175° and prolonged heating. Decarboxylation occurred little or not at all up to 185°, and then became perceptible above 185° C. The substantial decarboxylation at 195-200°, occurring at about the same rate as the esterification of the second carboxy group (Figure 5), indicated an upper temperature limit for a reasonable diesterification with minimal side reaction.

The total reaction (column 4), signifying loss of the second carboxy group by diesterification or decarboxylation, is equal to the sum (column 7) of the per cent diester formed, as determined by removal of the monester by alkaline washes (column 5) and the per cent  $\text{CO}_2$  evolved (column 6) (Table I).

**REACTION OF A SIMPLE POLYESTER WITH TBPA.** Polyesterification in the usual manner of a simple system, 2.2 DEG/1.0MA/0.5PA, gave a polyester with an acid number of 13.7 (Figure 4). Addition of 0.5 mole of TBPA to the hot polyester yielded a new one, having an acid number of 63.5. This compared favorably with the theoretical acid number of 59.9 for the new polyester, calculated on basis of TBPA conversion to the monoester (Figure 4). The second step was complete in one-half hour, the time required to dissolve the TBPA. A further drop in the acid number was, however, very slow and probably due to diesterification, decarboxylation, or both, as indicated in the next section.

(see page 383, left

col.).

In the TBPA-polyester resins, a diverse range of glycol, unsaturated acid, thin-out acid, and crosslinking agent may be used with retention of fire-retardancy, if the Br content of the resin is above ca. 12.5% by weight. In TBPA-epoxy resins, even less Br, about 9 to 11%, imparts fire-retardancy.

(see page 390, left

col.).

However, the instant invention differs from the prior art in that there is a specific decarboxylation catalyst used in the claimed process unlike the prior art process; the claimed reactor includes a plurality of heated reactors in series.

Hill et al discloses the method of preparing tetrabromobenzoate esters in the following example (see col. 8 ,lines 10-27):

**Synthesis of 2-ethylhexyltetrabromobenzoate from  
tetrabromophthalic anhydride in 2-ethoxyethylether  
solvent**

Tetrabromophthalic anhydride (1391 g., 3.00 moles), 2ethylhexanol (469 g, 3.60 moles), 2-ethoxyethylether (771 g, 4.75 moles), and sodium bicarbonate (25 g, 0.30 moles) were charged to a stirred, glass vessel. The mixture was brought to reflux, with the water of reaction being collected in a Dean-Stark trap. After CO<sub>2</sub> evolution had ceased (approximately 3 hours), the reaction was cooled and filtered to remove the catalyst. The 2-ethoxyethylether and excess 2-ethylhexanol were stripped off under vacuum yielding a clear, amber liquid product. GLC assay 85.0% tetrabromobenzoate, 1.6% tetrabromophthalic diester; OBr 56.99%; TGA 5% wt. loss 209° C., Gardner color 11.

Furthermore, the boiling point for the inert solvents between 160 to 230° C is recommended (see col. 5 ,lines 62-64).

Also, the Hill et al has indicated that the reaction process is actually involved in a two step procedure : 1. esterification of the anhydride ;2. decarboxylation to yield the tetrabromobenzoate (see col. 1 ,lines 46-48).

In addition, Hill et al teaches the incorporation of 2-ethylhexyltetrabromobenzoate to unsaturated polyester resin as the flame retarded polymer resin component in the combustibility test (see col. 10 , lines 31-42) as well as the use of tetrabromobenzoate in the flame retardant reaction injection molded polyurethane (see col. 9 ,lines 35-48).

With respect to the employment of the plurality of heated reactors in series, this is related to the optimization of the process. If the skilled artisan in the art had desired to employ the industrial process, it would have been obvious to the skilled artisan in the art to be motivated to apply the plurality of heated reactors in series so as to optimize the cost of operations.

Spatz et al does disclose the reaction step that favors partial esterification over complete esterification to form a tetrabromophthalate half-ester intermediate mixture as well as another step that favors decarboxylation over esterification under specific reaction temperatures. Similarly, the Hill et al expressly has disclosed the method of preparing tetrabromobenzoate esters from tetrabromophthalic anhydride in the presence of sodium carbonate decarboxylation catalyst (see col. 5 ,line 39), which is actually involved in a two step procedure ( esterification of the anhydride and the subsequent decarboxylation to yield the tetrabromobenzoate) (see col. 1 ,lines 46-48).

Both processes have been commonly involved in the method of preparing tetrabromobenzoate esters from the reaction of tetrabromophthalic anhydride and the same alcohol; Hill et al expressly has offered guidance that it is in the presence of sodium carbonate that the preparation of tetrabromobenzoate ester from tetrabromophthalic anhydride can be accelerated with little cost (see col. 1 ,lines 50-52) Therefore, it would have been obvious to the skilled artisan in the art to be motivated to incorporate the Hill's et al decarboxylating catalyst into the Spatz et al process in order to speed up the reaction process and react all the reactants to its completion. This

is because the skilled artisan in the art would expect such a combination to be successful , efficient ,and less costly as the guidance shown in the Hill et al .

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Taylor Victor Oh whose telephone number is 571-272-0689. The examiner can normally be reached on 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas McKenzie can be reached on 571-272-0670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

To avoid abandonment of the application, appellant must exercise one of the following two options:

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(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:



Thomas McKenzie, Ph.D.

Supervisor

Art Unit 1625

  
Taylor Victor Oh  
Primary Examiner  
Art Unit 1625  
11/966